

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER
FGRM PTO-1390 (Modified) (REV 11-2000)		220803US0PCT
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		U.S. APPLICATION NO (IF KNOWN, SEE 37 CFR 10/070450
INTERNATIONAL APPLICATION NO PCT/EP00/09135	INTERNATIONAL FILING DATE 18 September 2000	PRIORITY DATE CLAIMED 20 September 1999
TITLE OF INVENTION ELECTROLYTIC TRANSFORMATION OF ORGANIC COMPOUNDS		
APPLICANT(S) FOR DO/EO/US PUETTER Hermann et al.		
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:		
<ol style="list-style-type: none"> 1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. 2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371. 3. <input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below. 4. <input checked="" type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31). 5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) <ol style="list-style-type: none"> a. <input type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau) b. <input checked="" type="checkbox"/> has been communicated by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US). 6. <input checked="" type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)). <ol style="list-style-type: none"> a. <input checked="" type="checkbox"/> is attached hereto. b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4). 7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) <ol style="list-style-type: none"> a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau) b. <input type="checkbox"/> have been communicated by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input checked="" type="checkbox"/> have not been made and will not be made 8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)). 9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). 10. <input type="checkbox"/> An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)). 11. <input type="checkbox"/> A copy of the International Preliminary Examination Report (PCT/IPEA/409) 12. <input checked="" type="checkbox"/> A copy of the International Search Report (PCT/ISA/210) 		
Items 13 to 20 below concern document(s) or information included:		
<ol style="list-style-type: none"> 13. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98. 14. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included 15. <input checked="" type="checkbox"/> A FIRST preliminary amendment. 16. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment. 17. <input type="checkbox"/> A substitute specification 18. <input type="checkbox"/> A change of power of attorney and/or address letter. 19. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter 2 and 35 U.S.C. 1821 - 1825 20. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4) 21. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4). 22. <input type="checkbox"/> Certificate of Mailing by Express Mail 23. <input checked="" type="checkbox"/> Other items or information: 		
Notice of Priority Form PTO-1449 PCT/IB/304		

U.S. APPLICATION NO (IF KNOWN, SEE 37 CFR 10/070450	INTERNATIONAL APPLICATION NO. PCT/EP00/09135	ATTORNEY'S DOCKET NUMBER 220803US0PCT																
24. The following fees are submitted:		CALCULATIONS PTO USE ONLY																
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) : <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 85%;"><input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO</td> <td style="width: 15%; text-align: right;">\$1040.00</td> </tr> <tr> <td><input checked="" type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO</td> <td style="text-align: right;">\$890.00</td> </tr> <tr> <td><input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO</td> <td style="text-align: right;">\$740.00</td> </tr> <tr> <td><input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)</td> <td style="text-align: right;">\$710.00</td> </tr> <tr> <td><input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)</td> <td style="text-align: right;">\$100.00</td> </tr> </table>		<input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO	\$1040.00	<input checked="" type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO	\$890.00	<input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	\$740.00	<input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)	\$710.00	<input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)	\$100.00							
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Surcharge of \$130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492 (e)).		<input type="checkbox"/> 20 <input type="checkbox"/> 30 \$0.00																
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">CLAIMS</th> <th style="width: 25%;">NUMBER FILED</th> <th style="width: 25%;">NUMBER EXTRA</th> <th style="width: 25%;">RATE</th> </tr> </thead> <tbody> <tr> <td>Total claims</td> <td>11 - 20 =</td> <td>0</td> <td>x \$18.00</td> </tr> <tr> <td>Independent claims</td> <td>1 - 3 =</td> <td>0</td> <td>x \$84.00</td> </tr> <tr> <td colspan="2">Multiple Dependent Claims (check if applicable)</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">\$0.00</td> </tr> </tbody> </table>		CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	Total claims	11 - 20 =	0	x \$18.00	Independent claims	1 - 3 =	0	x \$84.00	Multiple Dependent Claims (check if applicable)		<input type="checkbox"/>	\$0.00	
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Total claims	11 - 20 =	0	x \$18.00															
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Multiple Dependent Claims (check if applicable)		<input type="checkbox"/>	\$0.00															
TOTAL OF ABOVE CALCULATIONS =		\$890.00																
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.		\$0.00																
SUBTOTAL =		\$890.00																
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TOTAL NATIONAL FEE =		\$890.00																
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable).		<input type="checkbox"/> \$0.00																
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		Amount to be: refunded \$ charged \$ 																
a. <input checked="" type="checkbox"/> A check in the amount of \$890.00 to cover the above fees is enclosed. b. <input type="checkbox"/> Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees A duplicate copy of this sheet is enclosed. c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 15-0030 A duplicate copy of this sheet is enclosed. d. <input type="checkbox"/> Fees are to be charged to a credit card. WARNING: Information on this form may become public Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.																		
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.																		
SEND ALL CORRESPONDENCE TO:																		
Surinder Sachar Registration No. 34,423																		
 22850																		
 SURINDER SACHAR SIGNATURE																		
Norman F. Oblon NAME																		
24,618 REGISTRATION NUMBER																		
March 20 2002 DATE																		

220803US-0PCT

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF : :

HERMANN PUETTER ET AL : ATTN: APPLICATION DIVISION

SERIAL NO: NEW U.S. PCT APPLN :
(Based on PCT/EP00/09135)

FILED: HEREWITH : :

FOR: ELECTROLYTIC TRANSFORMATION:
OF ORGANIC COMPOUNDS

PRELIMINARY AMENDMENT

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

SIR:

Prior to examination on the merits, please amend the above-identified application as follows:

IN THE CLAIMS

Please cancel Claims 1-9.

Please add the following new claims.

10. (New) A process for the electrolytic transformation of at least one organic compound in an electrolysis cell, wherein the organic compound is both oxidized and reduced at one electrode.

11. (New) The process as claimed in claim 10, wherein the organic compound is both oxidized and reduced at the anode.

12. (New) The process as claimed in claim 11, wherein the organic compound is reduced by hydrogenation.

13. (New) The process as claimed in claim 11, wherein the anode is in contact with at least one hydrogenation catalyst.

14. (New) The process as claimed in claim 13, wherein the hydrogenation catalyst is a noble metal.

15. (New) The process as claimed in claim 13, wherein the hydrogenation catalyst is applied to a graphite felt.

16. (New) The process as claimed in claim 13, wherein the hydrogenation catalyst is deposited on the anode from suspension.

17. (New) The process as claimed in claim 13, wherein the hydrogenation catalyst in the form of a suspension is brought into contact with the anode.

18. (New) The process as claimed in claim 10, wherein the organic compound is both reduced and oxidized at the cathode.

19. (New) The process as claimed in claim 10, wherein the electrode is a gas diffusion electrode.

20. (New) The process as claimed in claim 10, wherein the organic compound is furan or a furan derivative or furan and a furan derivative.

REMARKS

Claims 10-20 are active in the present application. Claims 1-9 have been cancelled.

Claims 10-20 are new claims. Support for the new claims is found in the original claims. No new matter is believed to have been added by this amendment. An action on the merits and allowance of claims is solicited.

Respectfully submitted,

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Marked-Up Copy

Serial No:

Amendment Filed on:

3-20-2002

IN THE CLAIMS

Claims 1-9 (Cancelled).

Claims 10-20 (New).

O.Z. 0050/50738

AS ORIGINALLY FILED

Electrolytic transformation of organic compounds

5 The present invention relates to a process for the electrolytic transformation of organic compounds, in which one electrode simultaneously serves to transfer both oxidation and reduction equivalents.

10 An objective of preparative organic electrochemistry is to utilize the processes occurring in an electrochemical process at both electrodes in parallel.

15 An example of such a process is the oxidative dimerization of 2,6-dimethylphenol which is coupled with the dimerization of maleic esters (M.M. Baizer, in: H. Lund, M. M. Baizer (editors), *Organic Electrochemistry*, Marcel Dekker, New York, 1991, pages 142 ff.).

20 A further example is the coupled synthesis of phthalide and t-butylbenzaldehyde, as described in DE 196 18 854.

25 However, it is also possible to utilize the cathode process and the anode process to prepare a single product or to destroy one starting material. Examples of such electrochemical processes are the production of butyric acid (Y. Chen, T. Chou, J. Chin. Inst. Chem. Eng. 27 (1996) pages 337-345), the anodic dissolution of iron which is coupled with the cathodic formation of 30 ferrocene (T. Iwasaki et al., J. Org. Chem. 47 (1982) pages 3799 ff.) or the decomposition of phenol (A.P. Tomilov et al., Elektrokhimiya 10 (1982) page 239).

A new opportunity opens up when oxidation and reduction take place at one and the same electrode. This means that a substrate receives both oxidation and reduction equivalents either simultaneously or successively.

5

A successive transfer of oxidation and reduction equivalents at one electrode is possible, for example, in cyclic voltammetry in which the potential of the electrode switches between positive and negative values 10 at a predetermined rate within a period of time (cf., for example, D. Sawyer, A. Sobkowiak, J. Roberts Jr., *Electrochemistry for Chemists*, Second Ed., pages 68-78, John Wiley & Sons, Inc. New York 1995).

15 In the context of the present invention, it has now been found that an anode is able to transfer reduction equivalents to a substrate which has already taken up anodic redox equivalents.

20 The process is not restricted to the anode, but can likewise be carried out at the cathode under suitable conditions.

25 It is an object of the present invention to provide an electrochemical process in which an organic compound is oxidized in one electrode process and the oxidation product is reduced at the same electrode.

30 We have found that this object is achieved by the process of the present invention for the electrolytic transformation of at least one organic compound in an electrolysis cell, wherein the organic compound is both oxidized and reduced at one electrode.

35 In a preferred embodiment of the invention, the process of the present invention occurs in an undivided cell.

In a further preferred embodiment of the invention, the organic compound is both oxidized and reduced, preferably hydrogenated, at the anode.

5

In one preferred embodiment of the invention, the organic compound is hydrogenated by means of hydrogen at the one electrode, with hydrogen being formed as product at the other electrode or being supplied from outside to the electrolysis circuit.

10

In another preferred embodiment of the invention, the organic compound is both reduced and oxidized, preferably oxygenated, at the cathode. In the following, the invention will be illustrated by the example of anodes which simultaneously oxidize and hydrogenate.

15

Organic compounds which can be used as starting materials in the process of the present invention are in principle all organic compounds which have reducible groups, preferably a furan or a substituted furan.

20

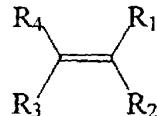
The process is not restricted to furan or substituted furans, but extends to all compounds and classes of compounds which are oxidizable or reducible or both by methods of organic electrochemistry. An overview of the classes of compounds is given by H. Lund, M. M. Baizer, (editors) "Organic Electrochemistry", 3rd edition, Marcel Dekker, New York 1991.

25

Suitable compounds of the stated classes are, for example, compounds containing double bonds, e.g.

30 35 1) Olefins:

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where R₁ to R₄ are each an alkyl, aryl or alkoxy group, a hydrogen atom, a (substituted) amino group, a halogen atom or a cyano group and the substituents R₁ to R₄ may 5 be identical or different.

The double bonds can be part of open-chain or cyclic 10 compounds, and can be part of the ring or of the chain or of both.

For the purposes of the present invention, cyclic 15 systems containing double bonds can be, in particular, aromatic systems.

In the compounds having a cyclic structure, one or more element(s) of the cyclic structure can be an unsubstituted or substituted heteroatom such as N, S, O, P.

20 The cyclic compounds may bear one or more functional substituents of the following types:

carboxyl groups, carbonyl groups (and N analogues), 25 carboxymethyl groups, nitrile groups, isonitrile groups, azo (azoxy) groups, nitro groups, amino groups, substituted amino groups, halogens.

2) Alkynes

30
$$R_5 \equiv R_6$$

where R₅ and R₆ are each a hydrogen atom or an aryl, alkyl, carboxyl or alkoxy carbonyl group, and the substituents R₅ and R₆ may be identical or different.

3) Carbonyl compounds



5 where R_7 and R_8 are each an aryl, alkyl, alkoxy or aryloxy group or a substituted amino group or a halogen atom, and the substituents R_7 and R_8 may be identical or different.

10 In a preferred embodiment of the process of the present invention, furan is used. Apart from furan, substituted furans such as the following compounds are also preferred:

15 furfural (furan 2-aldehyde), alkyl-substituted furans, furans bearing $-CHO$, $-COOH$, $-COOR$ groups, where R is an alkyl, benzyl, aryl or, in particular, a C_1-C_4 alkyl group, $-CH(OR_1)(OR_2)$ groups, where R_1 and R_2 may be identical or different and R_1 and R_2 are each an alkyl, benzyl, aryl or, in particular, C_1-C_4 -alkyl group, and

20 $-CN$ groups in the 2, 3, 4 or 5 positions.

In the reaction of organic compounds according to the present invention, it is possible to use solvents and electrolyte salts as are described in H. Lund, M. M. Baizer, (editors) "Organic Electrochemistry", 3rd edition, Marcel Dekker, New York 1991.

According to the present invention, the oxidation of furans is preferably carried out in the presence of methanol or in the presence of ethanol or a mixture thereof, but more preferably in the presence of methanol. These substrates can simultaneously be a reactant and solvent.

35 As solvents in the reaction of furans, it is generally possible to use all suitable alcohols in addition to

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the organic compound and the compound used for oxidation.

As electrolyte salts in the reaction of furans in the 5 process of the present invention, it is possible to use not only NaBr but also, for example, alkali metal halides and/or alkaline earth metal halides, with bromides, chlorides and iodides being conceivable as halides. Ammonium halides can likewise be used.

10

Pressure and temperature can be matched to the conditions which are customary in catalytic hydrogenations.

15

In a preferred embodiment of the process of the present invention, the reaction temperature T is $< 50^{\circ}\text{C}$, preferably $< 25^{\circ}\text{C}$, the pressure p is < 3 bar and the pH is in the neutral region.

20

In a preferred embodiment of the process of the present invention, intermediates are introduced in addition to the starting materials which are introduced into the preferably undivided electrolysis cell. The term intermediate refers to the product or products which 25 is/are obtained by the electrolytic oxidation according to the present invention of the organic compound or compounds, in particular a furan or a substituted furan or a mixture of two or more thereof, and is therefore present in the electrolysis circuit. The concentration 30 of additional intermediates is set by means of customary electrochemical and electrocatalytic parameters, for example current density and type and amount of catalyst, or the intermediate is added to the circuit.

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In respect of the specific choice of the material of the electrodes, there is no restriction in the process of the present invention, as long as the electrodes are suitable for the process as described above.

5

Preference is given to using graphite anodes in the electrolysis cell.

As regards the geometry of the electrodes in the 10 electrolysis cell, there are essentially no restrictions in the context of the present invention. Examples of preferred geometries are plane-parallel electrode arrangements and annular electrode arrangements.

15

In a preferred embodiment of the invention, the anode is in contact with at least one hydrogenation catalyst. In a particularly preferred embodiment, the hydrogenation catalyst or catalysts is/are part of a 20 gas diffusion electrode. In a further preferred embodiment of the invention, the anode is a graphite electrode coated with a noble metal in the form of plates, meshes or felts. In another preferred embodiment of the invention, the hydrogenation catalyst 25 is in the form of a suspension in the electrolyte and is continually brought into contact with the anode. Here, the hydrogenation catalyst, i.e. the catalytically active material, is pumped around the cell or is deposited on an appropriately structured 30 anode from suspension. An electrode of the latter type is described, for example, in DE 196 20 861.

In the process of the present invention, an organic compound is reduced, preferably hydrogenated, at the 35 anode by means of the hydrogen which is formed as product in the cathode process. This hydrogenation

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preferably takes place by the compound to be hydrogenated being brought into contact with one or more hydrogenation catalysts which are in turn brought into contact with the anode.

5

As regards the choice of hydrogenation-active catalysts, there are in principle no restrictions for the purposes of the process of the present invention. All catalysts known from the prior art can be used.

10 Examples which may be mentioned are the metals of transition groups I, II and VIII of the Periodic Table, in particular Co, Ni, Fe, Ru, Rh, Re, Pd, Pt, Os, Ir, Ag, Cu, Zn and Cd.

15 According to the present invention, it is possible, for example, to use the metals in finely divided form. Examples are Raney Ni, Raney Co, Raney Ag and Raney Fe, which may further comprise other elements such as Mo, Cr, Au, Mn, Hg, Sn as well as S, Se, Te, Ge, Ga, P, Pb, 20 As, Bi or Sb.

It is naturally also possible for the hydrogenation-active materials described to comprise a mixture of two or more of the specified hydrogenation metals, which 25 may be contaminated by, for example, one or more of the abovementioned elements.

Of course, it is also conceivable for the hydrogenation-active material to be applied to an inert 30 support. As such support systems, it is possible to use, for example, activated carbon, graphite, carbon black, silicon carbide, aluminum oxide, silicon dioxide, titanium dioxide, zirconium dioxide, magnesium dioxide, zinc oxide or mixtures of two or more thereof, 35 e.g. as a suspension or as fine granules.

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In a preferred embodiment of the present invention, the hydrogenation-active material is applied to a base material for gas diffusion electrodes.

5 The present invention accordingly also provides a process as described above in which the base material for gas diffusion electrodes is laden with a hydrogenation-active material.

10 Possible hydrogenation-active materials with which the gas diffusion electrode system is laden are all the above-described hydrogenation catalysts. Of course, it is also possible to use a mixture of two or more of these hydrogenation catalysts as hydrogenation-active material.

15

For the purposes of the process of the present invention, it is naturally also conceivable for the gas diffusion electrode material to be laden with hydrogenation-active material and for use to be made of additional hydrogenation-active material which is identical to or different from that with which the gas diffusion electrode material is laden.

25 Furthermore, the present invention provides, in general form, for the use of a gas diffusion electrode for the electrolytic transformation of an organic compound, preferably an unsaturated organic compound, in an electrolysis cell.

30 The following examples illustrate the present invention.

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Example 1

An undivided cell having 6 annular electrodes having a surface area per side of 15.7 cm² was used. The 5 electrodes were separated from one another by 5 spacer meshes having a thickness of 0.7 mm.

The electrodes comprised graphite plates each having a thickness of 5 mm and having one side coated with gas 10 diffusion electrode material. This material was in turn laden with 5.2 g of Pd/m².

The gas diffusion electrode was made the cathode.

The electrolyte mixture consisted of 30 g of furan, 15 57.4 g of 2,5-dimethoxydihydrofuran, 2 g of NaBr and 110.6 g of methanol.

The electrolysis was carried out at 0.5 A and a temperature of about 17°C. The cell voltage rose from 20 14.6 V to 20.7 V. The electrolysis was followed by gas chromatography.

After 1 F/mol of furan, the GC-percent by area of furan had been reduced from 22.7% to 17.8%, while the 25 proportion of dimethoxydihydrofuran remained constant at 31 percent by area. At the same time, 0.9% of 2,5-dimethoxytetrahydrofuran was formed.

This example shows that the cathode is capable of 30 catalytic hydrogenation. When graphite plates alone are used, i.e. not in the presence of a hydrogenation catalyst, good yields of 2,5-dimethoxydihydrofuran are obtained in agreement with the literature (H. Lund, M. M. Baizer, *Organic Electrochemistry*, Marcel Dekker, New 35 York, 1991, page 720); 2,5-dimethoxytetrahydrofuran is not disclosed and was not found.

Example 2

Example 2 was carried out using the arrangement from
5 Example 1, but here the anode was provided with
electrocatalytically active material. Instead of a gas
diffusion cathode, a gas diffusion electrode laden with
5.2 g of Pd/m² was used as anode.

10 The electrolyte mixture consisted of 30 g of furan,
57.4 g of 2,5-dimethoxydihydrofuran, 2 g of NaBr and
110.6 g of methanol.

15 The electrolysis was carried out at 0.5 A and a
temperature of 17°C. The cell voltage rose from 16.3 V
to 19.5 V. The electrolysis was followed by gas
chromatography.

20 After 1 F/mol of furan, the GC-percentage by area of
furan had been reduced from 22.7 to 16.9%, and the GC-
percentage by area of 2,5-dimethoxydihydrofuran
remained at 30%. At the same time, 3.3% of 2,5-
dimethoxytetrahydrofuran were formed.

25 The comparison shows that the anode operates even more
effectively than the cathode. This arrangement is thus
not purely dependent on the presence of catalytically
active material in the cells.

We claim:

- 5 1. A process for the electrolytic transformation of at least one organic compound in an electrolysis cell, wherein the organic compound is both oxidized and reduced at one electrode.
- 10 2. A process as claimed in claim 1, wherein the organic compound is both oxidized and reduced, in particular hydrogenated, at the anode.
- 15 3. A process as claimed in claim 1 or 2, wherein the electrode is in contact with at least one hydrogenation catalyst, in particular a noble metal.
- 20 4. A process as claimed in claim 3, wherein the hydrogenation catalyst, in particular the noble metal, is applied to a graphite felt.
- 25 5. A process as claimed in claim 3, wherein the hydrogenation catalyst is deposited on the anode from suspension.
- 30 6. A process as claimed in claim 3, wherein the hydrogenation catalyst in the form of a suspension is brought into contact with the anode.
7. A process as claimed in claim 1, wherein the organic compound is both reduced and oxidized, in particular oxygenated, at the cathode.

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8. A process as claimed in any of claims 1 to 7, wherein the electrode is a gas diffusion electrode.
- 5 9. A process as claimed in any of claims 1 to 8, wherein the organic compound is furan and/or a furan derivative.

O.Z. 0050/50738

Electrolytic transformation of organic compounds

Abstract

In a process for the electrolytic transformation of at least one organic compound in an electrolysis cell, the organic compound is both oxidized and reduced at one electrode.

Declaration, Power of Attorney

Page 1 of 3

0050/050738

We (I), the undersigned inventor(s), hereby declare(s) that:

My residence, post office address and citizenship are as stated below next to my name,

We (I) believe that we are (I am) the original, first, and joint (sole) inventor(s) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Electrolytic transformation of organic compounds

the specification of which

[] is attached hereto.

[] was filed on _____ as

Application Serial No. _____

and amended on _____.

[x] was filed as PCT international application

Number PCT/EPO0/09135

on September 18, 2000

and was amended under PCT Article 19

on _____ (if applicable).

We (I) hereby state that we (I) have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

We (I) acknowledge the duty to disclose information known to be material to the patentability of this application as defined in Section 1.56 of Title 37 Code of Federal Regulations.

We (I) hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed. Prior Foreign Application(s)

Application No.	Country	Day/Month/Year	Priority Claimed
19944990.2	Germany	20 September 1999	[x] Yes [] No

Declaration
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We (I) hereby claim the benefit under Title 35, United States Codes, § 119(e) of any United States provisional application(s) listed below.

(Application Number) _____
(Filing Date)

(Application Number) _____
(Filing Date)

We (I) hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

Application Serial No.	Filing Date	Status (pending, patented, abandoned)
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

And we (I) hereby appoint: Norman F. Oblon, Registration Number 24,618;
 Marvin J. Spivak Registration Number 24,913;
 Gregory J. Maier, Registration Number 25,599;
 William E. Beaumont, Registration Number 30,996;
 Steven B. Kelber, Registration Number 30,073;
 Jean-Paul Lavallee, Registration Number 31,451;
 Timothy R. Schwartz, Registration Number 32,171;
 Stephen G. Baxter, Registration Number 32,884;
 Richard L. Treanor, Registration Number 36,379;
 Robert W. Hahl, Registration Number 33,893, our (my) attorneys, with full

powers of substitution and revocation, to prosecute this application and to transact all business in the Patent Office connected therewith; and we (I) hereby request that all correspondence regarding this application be sent to the firm of **OBLON, SPIVAK, McCLELLAND, MAIER & NEUSTADT, P. C.**, whose Post Office Address is: Fourth Floor, 1755 Jefferson Davis Highway, Arlington, Virginia 22202.

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We (I) declare that all statements made herein of our (my) own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Declaration

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